TETRA TECH

PHIL-25826

October 10, 2014

Project Number 04635

Mr. Brad White (3HS22)
U.S. Environmental Protection Agency (EPA) Region 3
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

Reference: Remedial Action Contract - EPA Region 3
EPA Contract Number EP-S3-07-04

Subject: Proposed Round 3 ISCO Injection Approach
Valmont TCE Site
Long-Term Remedial Action (LTRA)
EPA Work Assignment No. 052-RALR-031M

Dear Mr. White:

This letter provides information regarding future implementation of the in-situ chemical oxidation (ISCO) remedy to address contaminated groundwater attributable to the site. More specifically the enclosure summarizes the revised approach for the next round of ISCO injections (i.e., Round 3) based on current TCE concentrations, post-injection monitoring results, past ISCO injection events, groundwater flow directions, and other relevant factors. The approach recommends the injection of roughly 9,000 gallons of oxidant solution into up to 13 wells and 19 intervals.

Please contact me if you have any questions or comments.

Sincerely,

Neil Teamerson

Neil Teamerson
Project Manager

NT/nfs

Enclosure

c: Vince Shickora (Tetra Tech)
File No. 3

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PROPOSED ROUND 3 ISCO INJECTION APPROACH
VALMONT TCE SITE
WEST HAZLETON BOROUGH AND HAZLE TOWNSHIP, PENNSYLVANIA

1.0 INTRODUCTION

This enclosure provides information regarding future implementation of the in-situ chemical oxidation (ISCO) remedy to address contaminated groundwater attributable to the site. More specifically, it summarizes the proposed approach for the next round of ISCO injections (i.e., Round 3) based on current TCE concentrations, post-injection monitoring results, past ISCO injection events, groundwater flow directions, and other relevant factors. The approach recommends the injection of roughly 9,400 gallons of oxidant solution into up to 13 wells and 19 intervals.

Tetra Tech performed comprehensive groundwater monitoring in August and September 2014; however, the analytical results are not yet available. If these results are received prior to the start of Round 3 fieldwork, Tetra Tech will evaluate them with respect to modifying the Round 3 approach. Flow maps for deep and shallow and deep groundwater are provided as Figures 1 and 2, respectively, based on September 2014 water elevation measurements.

Injection well locations are shown on Figure 3. Permission to perform injection work and other field tasks will be obtained by Tetra Tech and EPA. Several locations are on or adjacent to paved areas or on a grassy lawn where soft ground may be encountered. Six locations (i.e., wells E-9 through E-14) are inside the warehouse building. Vehicular and equipment access to these five locations is restricted by a 10-foot-by-10-foot garage door. In addition, the ceiling height within the building is approximately 17 feet and the current tenant has cardboard-boxed product stored around and on some well locations. Tetra Tech will arrange for the garage door to be opened and will coordinate all inside injections with tenant personnel to have boxed product removed. The floor within the building consists of an approximate 6-inch thick concrete pad and contains steel-reinforced rebar.

2.0 SCOPE OF WORK

A total of 13 wells have been selected to conduct injections at the site. Up to two zones (or intervals) will be utilized per well. Tetra Tech assumes that a double packer assembly will be used for most injections and that each packer will be inflated to the appropriate pressure for each zone. The assembly will be constructed to allow adjustments to be made as necessary for each proposed injection zone. The assembly could include a 10 to 50-foot spread between packers.

Water-level measurements and pressure readings will be taken from the near the selected injection well along with measurements from nearby wells to determine the influence of the injected volume of oxidant solution.

Tetra Tech assumes that concentrated 10% sodium permanganate ($NaMnO_4$) solution will be utilized for the injections at the site. The Tetra Tech field representative will make the final decision on all safety procedures. All Subcontractor personnel shall be required to attend a brief lecture on site-specific safety, to be given just before the commencement of work.

2.1 Task 1 - Mobilization/Demobilization

This task includes mobilizing all equipment, materials, and labor required to complete the project to the jobsite; setup of an equipment lay down area; per diem for a field crew, as needed; attendance of an approximately 1-hour site-specific health and safety meeting and compliance with all health and safety requirements for the project; site clean-up; demobilization from the site; and any other work items not mentioned in the remaining work tasks but necessary for the performance of work activities.

A site-specific health and safety orientation meeting will be held during mobilization, prior to the initiation of any on-site activities. All Subcontractors shall meet the requirements of both OSHA 1910.120 and Tetra Tech as set forth in the Health and Safety Plan (HASP) (Tetra Tech, 2011). The HASP will be available onsite for review upon request. One orientation meeting will be held and all Subcontractor representatives and potential substitute personnel performing onsite work activities will be required to attend. No substitute personnel will be allowed to work without training. Personnel and equipment decontamination is discussed in the HASP.

The supporting Subcontractor will provide 55-gallon drums for wastewater/decontamination water generated during injection activities. The drums will be stored at a centrally located area. It will be the responsibility of the Subcontractor to provide temporary, mobile holding tanks to support the following work:

- Collect and transport water and decontamination fluids.
- Collect and transport the oxidant solution to locations near the selected injection wells.
- Collect, haul, and transfer wastewater to the staging area.

The Subcontractor will be responsible for providing and operating pumps for transferring wastewater on site. It is likely that any residual materials from injection activities will need to be contained and transported back to a central marshaling area.

2.2 Task 2 - Low to Moderate Pressure Injection Support Activities

This task includes two items.

- Task 2A - Initial Set-Up and Tear-Down
- Task 2B - Oxidant Solution Injections

2.2.1 Task 2A - Initial Set-Up and Teardown

The Subcontractor will provide all equipment, materials, and labor required to set up all of the required injection equipment at the site and to conduct any preliminary tasks to ensure the objectives of the work can be met. Initial activities may include any necessary trial runs or pilot testing to ensure that the oxidant solution can be successfully injected during Task 2A. Task 2A includes the effort to perform teardown and decontamination activities related to injections.

2.2.2 Task 2B - Oxidant Injections

The Subcontractor will provide all equipment, materials, and labor required to perform injection activities at selected depths within the injection wells, including, but not limited to a portable 500-gallon permanganate holding tank, a double packer assembly (with adjustable 10-foot to 50-foot spreads), a suitable power source, water injection pumps capable of and suitable for injecting the oxidant solution under pressures ranging up to 200 psi and at depths ranging up to 100 feet, all required piping, pressure gauges and flow meters, and any necessary materials required to complete the injections.

The general procedure for each injection includes isolating the desired depth interval using a set (or single packer) of inflatable or mechanical packers, pumping the $NaMnO_4$ solution into the target interval under increasing pressures until a maximum pressure of approximately 200 psi occurs and continuing to inject the solution until the required volume has been injected into the specified interval. This procedure will be repeated for each targeted depth zone within the well typically starting with the deepest zone and working upward to the shallowest.

The $NaMnO_4$ solution will be purchased by Tetra Tech and will be stored onsite in a 5,000-gallon poly tank. This tank will be positioned at a centrally located area of the site, most likely near wells MW-11S and MW-11D along the eastern side of the existing building. The oxidant solution will be pumped from the tank by the Subcontractor into portable 500-gallon poly tank(s) and transferred to each injection well location as necessary. The 5,000-gallon tank will have secondary containment using dimensional lumber and plastic sheeting.

The primary objective of the Round 3 ISCO approach is to use the newly installed injection wells inside the building to destroy or reduce the mass of VOCs contained within the 1,000 micrograms per liter (µg/L) contour for trichloroethene (TCE) in relatively shallow groundwater. Several other injection wells, both open borehole and screened wells, will also be utilized to support the primary objective. All E-series wells are either 6-inch or 8-inch diameter open-borehole wells. A dual or single packer assembly will be used depending on the selected injection interval for these wells. The packer inflation pressures will be at least 2,000 psi.

The pressure generated during injections should be between 1 and 100 psi. However, the pumps used by the Subcontractor must be capable of achieving up to 200 psi at depths up to 100 feet below ground surface (bgs). The pressure and flow will be monitored by the use of in line gauges/meters. The total volume of oxidant solution to be injected into each 8-inch well zone is shown in Table 1. Example calculations of the volume required are provided as Attachment 1.

Several wells may exhibit the presence of permanganate as evaluated during the August 2014 groundwater monitoring event. The following wells contained some presence of permanganate:

- E-3: color was dark purple; not sampled.
- E-4: light reddish brown; sample collected.
- E-6: dark purple; not sampled.
- E-7: purple; not sampled.
- E-9: pink; sample collected.
- MW-11D: purple; not sampled.
- MW-12S: purple; not sampled.
- MW-22D: dark purple, not sampled.

Except for well E-3, no injection activities are proposed for these wells at this time. During injections at wells E-3, E-10, and E-11, Tetra Tech will monitor water levels and pressure in wells E-6 and E-9 to determine whether injected solutions have influenced these wells. Similarly, well E-4 will be monitored during injections at wells E-11, E-12, and E-13. Both wells E-4 and E-6 may be used to inject any remaining oxidant solution, which could not be injected into proposed wells due to various factors (i.e., wells unable to receive oxidant solution, wells that indicate day lighting may occur, etc.). Day lighting refers to surfacing of the oxidant solution.

Injection well E-5 is not proposed for Round 3 ISCO work. This well has been part of several previous injection events and the current TCE concentration (19 µg/L) is unremarkable. Instead, two wells

(MW-13S and MW-13I) will be part of the Round 3 injections to address groundwater contamination south of the apparent divide bisecting the site.

Well E-7 is also not included in the proposed Round 3 approach since the well currently contains permanganate. Well E-7 will be monitored during injections at wells E-1, E-2, and E-14 to determine if it is affected by these injections. If not significantly affected, Tetra Tech will discuss the Round 3 approach for this well with EPA.

No injection activities are planned for well E-8 due to past subsurface conditions that resulted in day lighting.

As noted, the focus of Round 3 injections is on the newly installed 6-inch diameter injection wells (E-10 through E-14). These are open borehole wells with steel surface casing installed to approximately 20 feet bgs. A dual or single packer assembly will be used depending on the selected injection interval for these wells. The packer inflation pressures will be at least 2,000 psi. The pressure generated during injections should be between 1-100 psi. The total volume of oxidant solution to be injected into each 6-inch well zone is shown in Table 1.

Injection activities will then be conducted at the monitoring wells listed in Table 1. These wells are 2-inch diameter screened polyvinyl chloride (PVC) wells. A single packer assembly or a fitted connection (e.g., Fernco) may be used within each well. The packer inflation will be of sufficient pressure to complete each injection without damaging the PVC casing and at the same time preventing any day lighting of the injection solution. The pressure generated during injections should be between 1-100 psi. However, the pumps utilized by the Subcontractor must be capable of achieving up to 200 psi at depths up to 88 feet bgs. The pressure and flow will be monitored by in line gauges/meters. The total volume of solution to be injected into each 2-inch diameter well is included in Table 1.

At this time, Tetra Tech is not proposing injections into wells MW-18S and MW-28S as part of Round 3. Shallow well MW-18S (screened between 14 and 36 feet bgs) revealed TCE at 730 µg/L during September 2014 sampling. During injections at wells E-3 and possibly E-10, Tetra Tech will monitor water levels and pressure to determine if this work affects MW-18S.

For MW-28S, Tetra Tech will monitor injections at wells E-12, E-13, and E-14 to determine if the well is influenced by other injections. MW-28S is screened from 35 to 45 feet bgs and both E-12 and E-13 are targeted for shallow injections generally between 20 and 56 feet bgs. If wells MW-18S and MW-28S are not significantly affected by other work, Tetra Tech will discuss the Round 3 approach for these wells with EPA.

The Subcontractor must demonstrate that the fitted connection (if used) provides a comparable measure of effectiveness for injections into monitoring wells. Two measures of effectiveness are the capability of the fitted connection to prevent surfacing of the oxidant solution as well as to allow for pressure injections into low yielding wells. Leak testing using only water must be performed to fulfill this demonstration. If the 2-inch PVC riser is damaged, or if leak testing is unsuccessful, the single packer approach will be used. The Tetra Tech field representative, and not the Subcontractor, is responsible for making the decision as to whether the fitted connection is appropriate.

All injection hoses will be tested by the Subcontractor and certified to meet expected injection pressures as specified in the scope of work. Certification of the hoses will be supplied to Tetra Tech prior to site activities. If necessary, portable lighting will be utilized by the subcontractor for any work conducted inside the site building. A large number of the building lights are currently non-operational and the areas around several injection locations are very dark. Spill containment pads or containment devices shall be installed under or around any permanganate transfer hoses/piping, which may need to be disconnected during injection activities.

Prior to the start of injections at individual wells, the field team will collect baseline groundwater levels in nearby wells to monitor relative changes in water-level elevations. During each injection, Tetra Tech will monitor groundwater levels in surrounding wells as shown in the table below.

WATER LEVEL READINGS

E-1	E-2	E-3	E-9	E-10	E-11	E-12	E-13	E-14
MW-10B MW-10C MW-15S MW-15I MW-28S MW-28I	MW-11S MW-11D MW-28S MW-31S E-7 E-8 E-14	MW-12S MW-12I MW-18S E-6 E-10	E-10 E-11 E-5 E-3 MW-13S	E-3 E-6 E-9 E-11	E-4 E-6 E-9 E-10 E-12	E-4 E-11 E-13 MW-31S MW-31I MW-28S	E-4 E-12 MW-31S MW-31I MW-28S MW-28I	E-2 E-7 MW-11S MW-11D MW-28S MW-31S MW-31I

WATER LEVEL READINGS

MW-11S	MW-10A	MW-13S	MW-13I	MW-18S	MW-28S	
E-14 E-2 E-8 MW-31S MW-28S MW-11D	E-1 MW-10B MW-10C E-7	MW-2S MW-2I MW-13D E-5 E-9	MW-13S MW-2S MW-2I E-5 E-9	Only if Used MW-12S MW-12D E-6	Only if Used MW-28I E-4	

Tetra Tech will use the groundwater level results to evaluate the radius of influence (ROI) associated with injections.

The field team will stop injections in the event that receiving wells indicate that surfacing of the oxidant solution may occur. Tetra Tech will adjust the flow rate of the injection pump to allow for stabilization of the water level in each receiving well, to obtain a consistent flow of oxidant solution, and to prevent day lighting. Containment pads will be installed around all injection wells to contain any possible spills or daylighting.

Based on round two injection observations, Tetra Tech does not plan to construct containment pads around surrounding wells during injection activities. Groundwater levels of surrounding wells will be monitored during injections and injection flow rates will be adjusted or halted if water level data indicates that injected solution may daylight in nearby wells. Tetra Tech will have mortar tubs or other containment pad items available if needed to contain daylighting on nearby wells.

A dilute (3-6%) sodium thiosulfate solution will be available for neutralization of spills and decon of equipment. Sorbent materials such as vermiculite or kitty litter will also be available for spill containment. For personal decontamination, the team will use a dilute hydrogen peroxide/vinegar/water solution. The field team will containerize all wastes in 55-gallon drums for off-site disposal following completion of injection activities.

Round 3 ISCO injections may be limited by the amount of $NaMnO_4$ solution each receiving well can accept, particularly for screened monitoring wells. To the extent practicable, Tetra Tech will inject the volumes listed in Table 1. For planning, however, the following guidelines will support decision-making in the field regarding the injection program:

1. Surfacing of the oxidant solution will result in immediate cessation of injection activities at a well interval. The team will take precautions for those wells with two targeted intervals if the deepest interval injections previously resulted in surfacing.

2. Pressures greater than 100 psi will not be exceeded during injections. Well intervals unable to receive the oxidant solution at this pressure will not be used for injections.

3. For monitoring (screened) wells containing TCE concentrations greater than 150 µg/L and unable to receive an average flow rate of at least 2 gpm, injections will continue for 4 hours if average flow is less than 0.5 gpm, or for 2 hours if average flow is between 0.5 and 1 gpm. This rule may apply to wells MW-10A, MW-11S, MW-13S, and MW-13I.

4. For all injection (open borehole) wells unable to receive an average flow of at least 5 gpm, injections will continue for up to 4 hours.

2.3 Task 3 - Waste Management and Oxidant Delivery

The Subcontractor will deliver and provide one 5,000-gallon poly tank to store the oxidant solution. The tank will be stored on the eastern side of the plant building. At the conclusion of Round 3 injection work, the Subcontractor will clean the poly tank and remove it from the site. It is assumed that the poly tank will not remain at the site for more than 2 weeks.

Any wastes generated during Round 3 will be containerized and transported off-site for disposal. The more likely wastes include wastewaters from the injection program, any spills that require neutralization, materials captured by containment structures around injection wells or monitoring wells, and materials captured at the decontamination pad. Tetra Tech assumes that up to five 55-gallon drums may be required for waste management.

Tetra Tech will issue a purchase order for the delivery of the pre-mixed 10% $NaMnO_4$ solution. The liquid $NaMnO_4$ material will be provided by the manufacturer, sent to an off-site blender, mixed to specifications, and delivered to the site in 5,000-gallon tankers. The tanker contents will be transferred to the 5,000-gallon tank. Two tanker deliveries are anticipated (total of 9,400 gallons) and will be scheduled most likely 1 week apart to support Round 3 work.

2.4 Task 4 - Post-Injection Support Activities

Upon completion of the injection work, the Subcontractors will remove all equipment, unused materials, and debris from the site. The site will be restored as nearly as practical to its condition before the work began. All structures or property damaged due to the Subcontractor’s negligence will be restored at their expense as nearly as possible to their original condition. All cleanup and restoration of the property will be to the complete satisfaction of Tetra Tech.

The Subcontractor will be required to decontaminate the equipment and materials needed in the performance of the work as described below. The Subcontractor will perform the decontamination at a location designated by Tetra Tech. Decontamination of down-hole equipment and pumps will consist of the following:

- Spray neutralization with sodium thiosulfate solution (if necessary).
- Pressure wash equipment using steam genie and potable water.
- Rinse equipment using potable water.

2.5 Task 5 - Post-Injection Monitoring

Tetra Tech will obtain groundwater samples from selected wells on a periodic basis following the Round 3 ISCO injection event. The program will help determine the effectiveness of the injections and measure the spread of the solution (both laterally and vertically). Tetra Tech assumes samples will be collected from selected wells for both chemical and physical parameter analyses.

For planning, Tetra Tech will conduct two rounds of performance monitoring after Round 3 injections. These events will occur at the end of Months 3 (tentatively January 2015) and 6 (April 2015). Low-flow sampling techniques will be employed for screened wells, while the team will purge one volume of groundwater from open borehole wells. If the permanganate ion (MnO_4^-) is present in a particular monitoring well, samples may not be taken from that well. If necessary, samples containing the presence of permanganate will be preserved using ascorbic acid in accordance with EPA/600/R-12/049 *Groundwater Sample Preservation at In-Situ Chemical Oxidation Sites - Recommended Guidelines* (EPA, 2012).

For each round of performance monitoring, samples will be collected from up to 34 wells. Samples will be analyzed for TCL VOCs using CLP Method SOM01.1 for each round. Table 2 provides the proposed list of wells. Tetra Tech assumes that these performance monitoring events will take at least 1 week per event (plus mobilization/demobilization and administrative support), and will include the sampling of no more than four open borehole wells per event. A three- to four-person team will perform the work. Selected wells will also be sampled for PFOA and PFOS analyses; however, these analyses are not intended to support an evaluation of the effectiveness of Round 3 injections.

After Round 3 injections, Tetra Tech will evaluate if monitoring wells near injection wells are affected by the oxidant solution based on the presence of permanganate's purple color in well water along with elevated manganese concentrations and ORP readings (referred to as process monitoring). Samples will not be collected for fixed-base laboratory analyses. The post-injection process monitoring events will occur up to four times. These events will occur during Months 1 (tentatively November 2014), 2 (December 2014), 4 (February 2015), and 6 (April 2015). Tetra Tech assumes that these process monitoring events may involve up to 30 wells each time, and will last approximately 2 days per event (including mobilization, equipment rentals, travel, and reporting). A three-person field team will perform the work.

Tetra Tech assumes that the total number of groundwater sampling events may be conducted according to a different timeline or interval. For example, it may be necessary to carry out five process monitoring events after Round 3 injections. This flexibility should be considered part of the proposed Round 3 approach, assuming the overall number of groundwater sampling events does not change.

3.0 SCHEDULE

The anticipated start date for injection activities is on or around November 10, 2014. The period of performance for injections will be set for November 21, 2014. Post-injection monitoring will be performed between December 2014 and April 2015.

TABLES

ENCLOSURE

TABLE 1
PROPOSED ROUND 3 ISCO INJECTION APPROACH
VALMONT TCE SITE
WEST HAZLETON BOROUGH AND HAZLE TOWNSHIP, PENNSYLVANIA

WELL	INJECTION VOLUME (gallons)	INTERVALS (in feet bgs)		TCE CONCENTRATION (µg/L)	COMMENTS
E-1	700	20-40	60-80	780 (6/09)	Double packer setup. 350 gals per interval.
E-2	350	32-52	NA	450 (12/13)	Double packer setup
E-3	350	40-60	NA	4,000 (5/09)	Permanganate present
E-4	TBD	30-50	65-85	250 (12/13)	Monitor E-12 and E-13 injections first before proceeding
E-5	0	43-63	NA	19 (12/13)	Injections not anticipated as part of Round 3
E-6	TBD	NA	NA	ND (11/12)	Permanganate present. Monitor E-10 injections before proceeding
E-7	TBD	18-38	40-60	190 (12/13)	Permanganate present. Monitor E-2 and E-14 injections before proceeding
E-8	0	NA	NA	165 (12/13)	Injections not anticipated during Round 3 due to past subsurface conditions
E-9	136	30-40	NA	9,200 (12/13)	Monitor E-10 injections first before proceeding
E-10	900	20-50	70-100	3,500 (9/14)	Double packer setup on shallow zone, single packer setup on deep zone
E-11	2,000	20-70	70-100	140,000 (9/14)	Double packer setup on shallow zone, single packer setup on deep zone
E-12	1,300	20-56	56-100	1,000 (assumed)	Double packer setup on shallow zone, single packer setup on deep zone
E-13	1,500	20-50	50-76	2,900 (9/14)	Double packer setup on shallow zone, single packer setup on deep zone
E-14	1,200	20-55	55-100	1,000 (assumed)	Double packer setup on shallow zone, single packer setup on deep zone
MW-10A	136	36-46	NA	210 (12/13)	Single packer setup on shallow zone
MW-11S	136	44-54	NA	2,800 (12/13)	Single packer setup on shallow zone
MW-13S	136	20-35	NA	150 (12/13)	Single packer setup on shallow zone
MW-13I	136	78-88	NA	370 (2/12)	Single packer setup on shallow zone
MW-18S	TBD	14-36	NA	730 (9/14)	Monitor E-3 and E-10 injections first before proceeding
MW-28S	TBD	35-45	NA	760 (9/14)	Monitor E-12 and E-13 injections first before proceeding
TOTAL	8,980				

(1) No injections planned for wells MW-11D, MW-12S, MW-22D due to presence of permanganate.

(2) Injections may not be needed for well MW-28S since new wells (e.g., E-12, E-13, and E-14) may address shallow groundwater contamination in this area.

TABLE 2
PROPOSED POST-INJECTION MONITORING PROGRAM
VALMONT TCE SITE
WEST HAZLETON BOROUGH AND HAZLE TOWNSHIP, PENNSYLVANIA

WELL	PROCESS	PERFORMANCE(2)	COMMENTS (1)
E-1	▲	▲	Proposed Round 3 Injection Well
E-2	▲	▲	Proposed Round 3 Injection Well
E-3	▲	▲	Proposed Round 3 Injection Well
E-4	▲	▲	Possible Round 3 Injection Well
E-5	--	▲	
E-6	▲	▲	Possible Round 3 Injection Well
E-7	▲	▲	Possible Round 3 Injection Well
E-8	--	▲	
E-9	▲	▲	Proposed Round 3 Injection Well
E-10	▲	▲	Proposed Round 3 Injection Well
E-11	▲	▲	Proposed Round 3 Injection Well
E-12	▲	▲	Proposed Round 3 Injection Well
E-13	▲	▲	Proposed Round 3 Injection Well
E-14	▲	▲	Proposed Round 3 Injection Well
2S	▲	▲	
2I	▲	▲	
6S	▲	▲	
6I	▲	▲	
10A	▲	▲	Proposed Round 3 Injection Well
10B	▲	--	
10C	▲	--	
11S	▲	▲	Proposed Round 3 Injection Well
11D	▲	▲	
12S	▲	--	
12I	▲	▲	
13S	▲	▲	Proposed Round 3 Injection Well
13I	▲	▲	Proposed Round 3 Injection Well
15S	▲	--	
15D	▲	--	
18S	▲	--	Possible Round 3 Injection Well
22D	▲	▲	
28S	▲	▲	Possible Round 3 Injection Well
28I	▲	--	
31S	▲	▲	
31I	▲	▲	
GW-9	▲	▲	
GW-21	--	▲	
TOTALS	34	30	Plus QA/QC samples

Notes:

(1) Selected wells containing the presence of permanganate during monitoring may be sampled at the direction of EPA.

(2) All performance samples will be analyzed for VOCs. Selected samples may be analyzed for total and dissolved metals, as well as for PFOA and PFOS.

FIGURES

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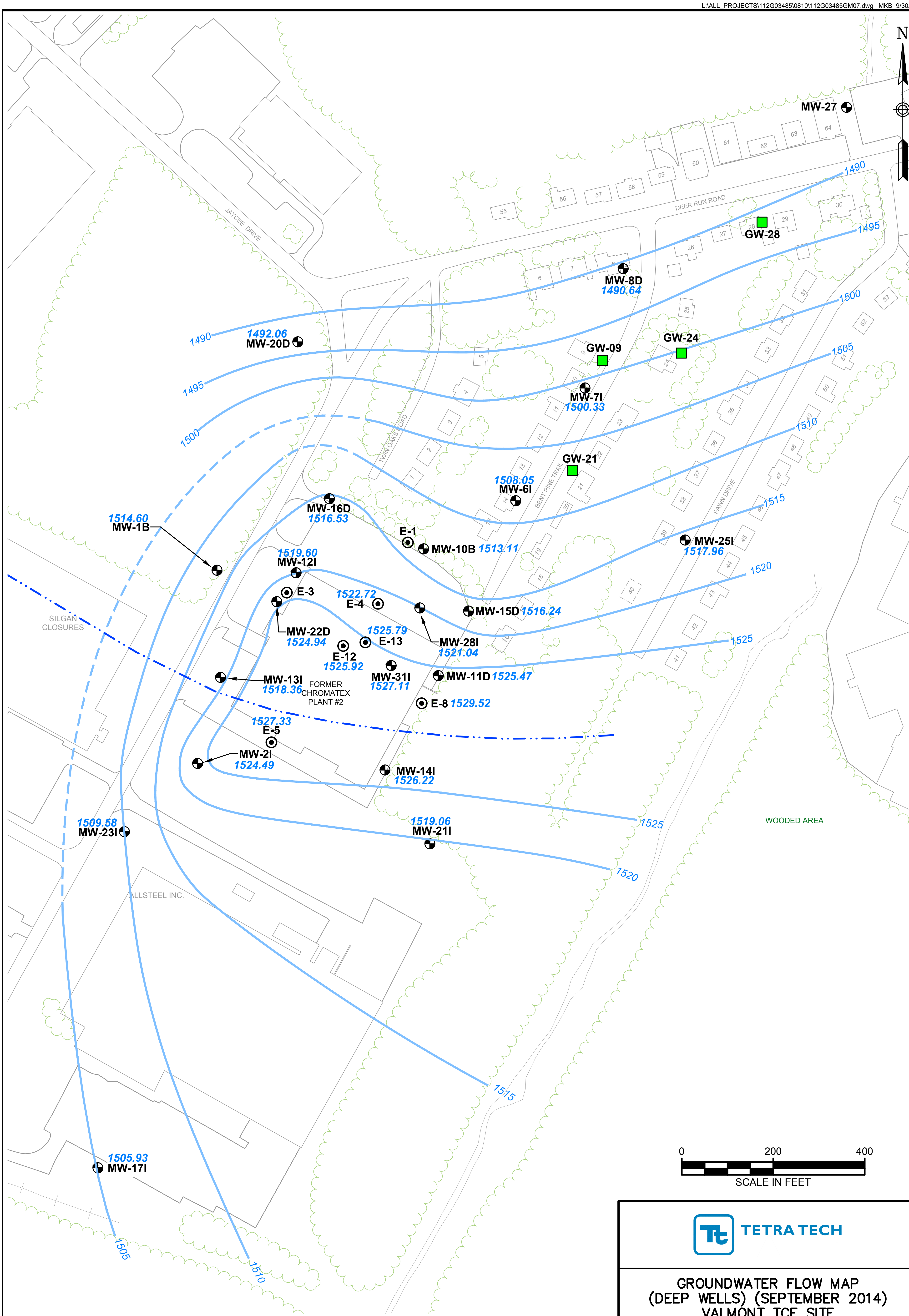

LEGEND

- MONITORING WELL
- INJECTION WELL
- RESIDENTIAL WELL
- 25 RESIDENCE
- GROUNDWATER DIVIDE
- 1518.30 ELEVATION MEASUREMENT (09/12/14)
- 1500 GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)

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GROUNDWATER FLOW MAP
(DEEP WELLS) (SEPTEMBER 2014)
VALMONT TCE SITE
HAZLE TOWNSHIP AND
WEST HAZLETON BOROUGH
LUZERNE COUNTY, PENNSYLVANIA

FILE	SCALE
112G03485GM07	AS NOTED

FIGURE NUMBER	REV	DATE
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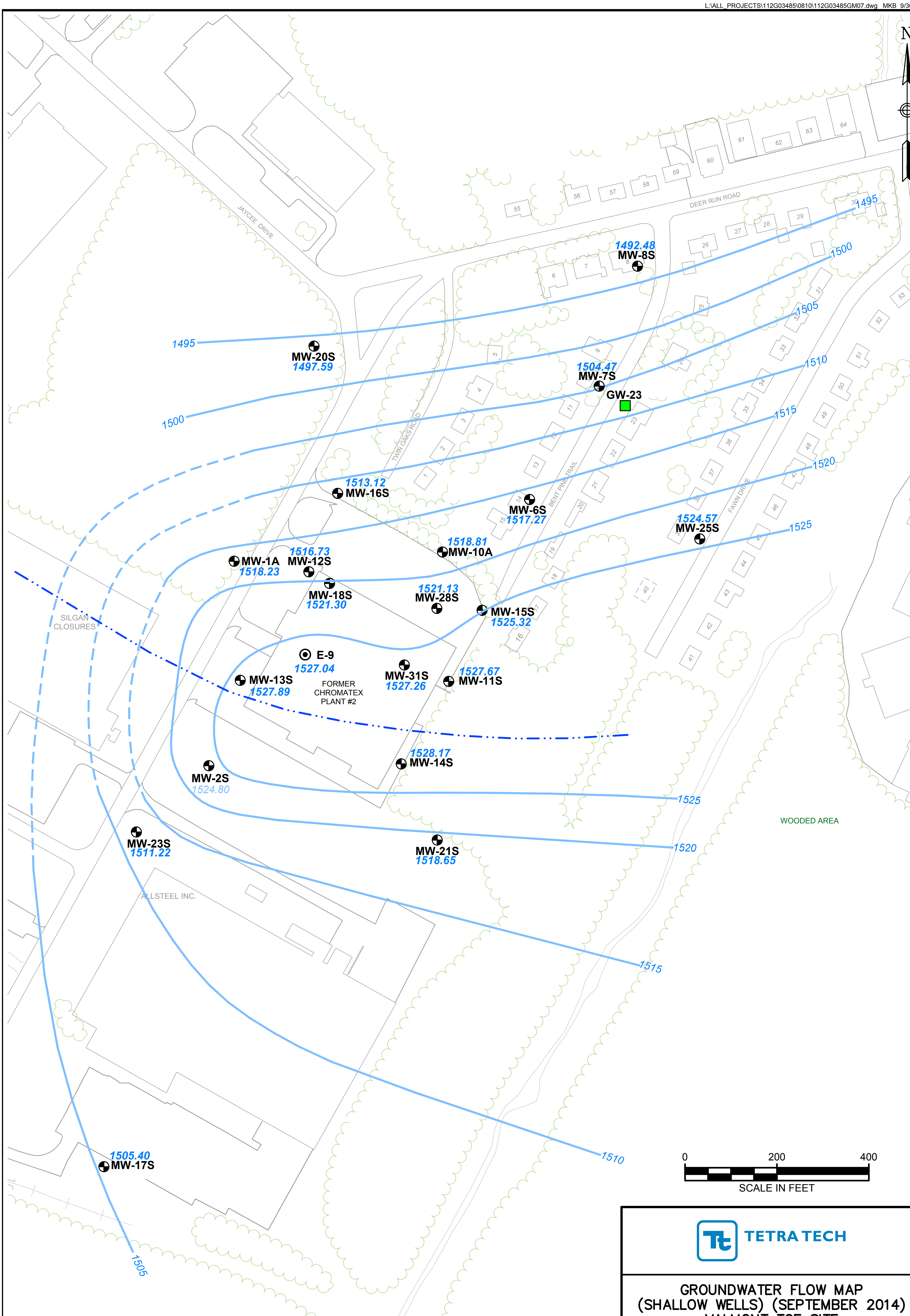

LEGEND

- MONITORING WELL
- INJECTION WELL
- RESIDENTIAL WELL
- 25 RESIDENCE
- GROUNDWATER DIVIDE
- 1518.30 ELEVATION MEASUREMENT (09/12/14)
- 1500 GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED)

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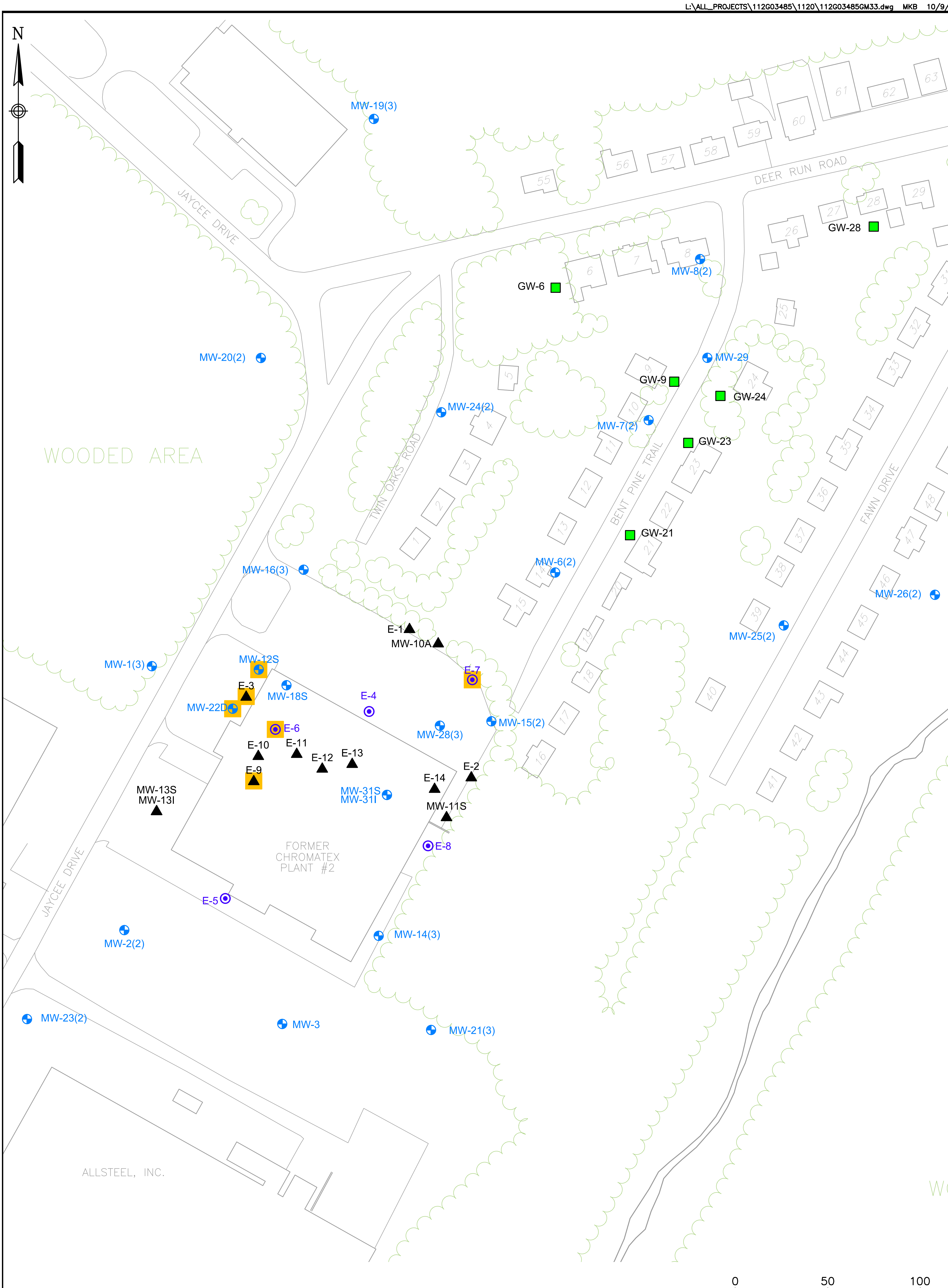
GROUNDWATER FLOW MAP
(SHALLOW WELLS) (SEPTEMBER 2014)
VALMONT TCE SITE
HAZLE TOWNSHIP AND
WEST HAZLETON BOROUGH
LUZERNE COUNTY, PENNSYLVANIA

FILE	SCALE
112G03485GM07	AS NOTED

FIGURE NUMBER	REV	DATE
2	0	09/30/14



LEGEND

- MONITORING WELL
- PAST INJECTION WELL
- ROUND 3 INJECTION WELL
- RESIDENTIAL WELL
- PRESENCE OF PERMANGANATE
- 25 RESIDENCE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PROPOSED ROUND 3
INJECTION WELL LOCATIONS
VALMONT TCE SITE
HAZLE TOWNSHIP AND
WEST HAZLETON BOROUGH
LUZERNE COUNTY, PENNSYLVANIA

SCALE	AS NOTED
REV 0	DATE 10/07/14
FILE	112G03485GM33
FIGURE NUMBER	FIGURE 3

ATTACHMENT 1

CARUS REMEDIATION TECHNOLOGIES

In Situ Chemical Oxidation (ISCO) *In Situ* Bioremediation (BIO) *In Situ* Biogeochemical Stabilization (ISBS)

RemOx® L ISCO Reagents Estimation Spreadsheet

Input data into box with blue font

Site Name: Valmont TCE Site, W. Hazleton, PA (Well E-1)
Date: 10/6/2014

	Estimates	Units	
Treatment Area Volume			
Length	**90**	ft	
Width	**60**	ft	
Area	5400	sq ft	
Thickness	**40**	ft	
Total Volume	8000	cu yd	
Soil Characteristics/Analysis			
Porosity	**1.2**	%	
Total Plume Pore Volume	19390	gal	
Avg Contaminant Conc	**0.8**	ppm	
Mass of Contaminant	0.13	lb	
PNOD	**3.1**	g/kg	
Effective PNOD	**1**	%	
Effective PNOD Calculated	0.031		
PNOD Oxidant Demand	736.56	lb	
Avg Stoichiometric Demand	**2.4**	lb/lb	
Contaminant Oxidant Demand	0.31	lb	
Theoretical Oxidant Demand	736.87	lb	
Confidence Factor	**1**		
Calculated Oxidant Demand	736.8707		
Injection Volumes for RemOx L			
RemOx L Injection Concentration	**10.0%**	%	
Calculated Specific Gravity	1.091623	g/ml	
Total Volume of Injection Fluid	726	gal	Two intervals; 350 gals/interval
Pore Volume Replaced	3.75	%	

Amount of RemOx L ISCO Reagent Estimated **1,654 pounds**
145 gallons

RemOx® L ISCO Reagents Estimation Spreadsheet

Input data into box with blue font

Site Name: Valmont TCE Site, W. Hazleton, PA (Well E-2)
Date: 10/8/2014

	Estimates	Units
Treatment Area Volume		
Length	**90**	ft
Width	**60**	ft
Area	5400	sq ft
Thickness	**20**	ft
Total Volume	4000	cu yd
Soil Characteristics/Analysis		
Porosity	**1.2**	%
Total Plume Pore Volume	9695	gal
Avg Contaminant Conc	**0.45**	ppm
Mass of Contaminant	0.04	lb
PNOD	**3.1**	g/kg
Effective PNOD	**1**	%
Effective PNOD Calculated	0.031	
PNOD Oxidant Demand	368.28	lb
Avg Stoichiometric Demand	**2.4**	lb/lb
Contaminant Oxidant Demand	0.09	lb
Theoretical Oxidant Demand	368.37	lb
Confidence Factor	**1**	
Calculated Oxidant Demand	368.3674	
Injection Volumes for RemOx L		
RemOx L Injection Concentration	**10.0%**	%
Calculated Specific Gravity	1.091623	g/ml
Total Volume of Injection Fluid	363	gal
Pore Volume Replaced	3.75	%

Amount of RemOx L ISCO Reagent Estimated — **827 pounds**, **72 gallons**

CARUS REMEDIATION TECHNOLOGIES

In Situ Chemical Oxidation (ISCO) *In Situ* Bioremediation (BIO) *In Situ* Biogeochemical Stabilization (ISBS)

RemOx® L ISCO Reagents Estimation Spreadsheet

Input data into box with blue font

Site Name: Valmont TCE Site, W. Hazleton, PA (Well E-3)

Date: 10/8/2014

	Estimates	Units
Treatment Area Volume		
Length	**90**	ft
Width	**60**	ft
Area	5400	sq ft
Thickness	**20**	ft
Total Volume	4000	cu yd
Soil Characteristics/Analysis		
Porosity	**1.2**	%
Total Plume Pore Volume	9695	gal
Avg Contaminant Conc	**4**	ppm
Mass of Contaminant	0.32	lb
PNOD	**3.1**	g/kg
Effective PNOD	**1**	%
Effective PNOD Calculated	0.031	
PNOD Oxidant Demand	368.28	lb
Avg Stoichiometric Demand	**2.4**	lb/lb
Contaminant Oxidant Demand	0.78	lb
Theoretical Oxidant Demand	369.06	lb
Confidence Factor	**1**	
Calculated Oxidant Demand	369.0567	
Injection Volumes for RemOx L		
RemOx L Injection Concentration	**10.0%**	%
Calculated Specific Gravity	1.091623	g/ml
Total Volume of Injection Fluid	364	gal
Pore Volume Replaced	3.75	%

Amount of RemOx L ISCO Reagent Estimated **829 pounds**
72 gallons

CARUS REMEDIATION TECHNOLOGIES

In Situ Chemical Oxidation (ISCO) *In Situ* Bioremediation (BIO) *In Situ* Biogeochemical Stabilization (ISBS)

RemOx® L ISCO Reagents Estimation Spreadsheet

Input data into box with blue font

Site Name: Valmont TCE Site, W. Hazleton, PA (Well E-10)
Date: 10/8/2014

	Estimates	Units	
Treatment Area Volume			
Length	90	ft	
Width	60	ft	
Area	5400	sq ft	
Thickness	50	ft	
Total Volume	10000	cu yd	
Soil Characteristics/Analysis			
Porosity	1.2	%	
Total Plume Pore Volume	24237	gal	
Avg Contaminant Conc	1	ppm	
Mass of Contaminant	0.20	lb	
PNOD	3.1	g/kg	
Effective PNOD	1	%	
Effective PNOD Calculated	0.031		
PNOD Oxidant Demand	920.7	lb	
Avg Stoichiometric Demand	2.4	lb/lb	
Contaminant Oxidant Demand	0.49	lb	
Theoretical Oxidant Demand	921.19	lb	
Confidence Factor	1		
Calculated Oxidant Demand	921.1854		
Injection Volumes for RemOx L			
RemOx L Injection Concentration	10.0%	%	
Calculated Specific Gravity	1.091623	g/ml	
Total Volume of Injection Fluid	908	gal	Two intervals; 450 gals/interval
Pore Volume Replaced	3.75	%	

Amount of RemOx L ISCO Reagent Estimated **2,068 pounds**
181 gallons

RemOx® L ISCO Reagents Estimation Spreadsheet

Input data into box with blue font

Site Name: Valmont TCE Site, W. Hazleton, PA (Well E-11)
Date: 10/8/2014

	Estimates	Units	
Treatment Area Volume			
Length	**90**	ft	
Width	**60**	ft	
Area	5400	sq ft	
Thickness	**60**	ft	
Total Volume	12000	cu yd	
Soil Characteristics/Analysis			
Porosity	**1.2**	%	
Total Plume Pore Volume	29084	gal	
Avg Contaminant Conc	**140**	ppm	
Mass of Contaminant	33.98	lb	
PNOD	**3.1**	g/kg	
Effective PNOD	**1**	%	
Effective PNOD Calculated	0.031		
PNOD Oxidant Demand	1104.84	lb	
Avg Stoichiometric Demand	**2.4**	lb/lb	
Contaminant Oxidant Demand	81.55	lb	
Theoretical Oxidant Demand	1186.39	lb	
Confidence Factor	**1.75**		
Calculated Oxidant Demand	2076.189		
Injection Volumes for RemOx L			
RemOx L Injection Concentration	**10.0%**	%	
Calculated Specific Gravity	1.091623	g/ml	
Total Volume of Injection Fluid	2,047	gal	Two intervals; 1,000 gals/interval
Pore Volume Replaced	7.04	%	

Amount of RemOx L ISCO Reagent Estimated **4,661 pounds**
408 gallons

RemOx® L ISCO Reagents Estimation Spreadsheet

Input data into box with blue font

Site Name: Valmont TCE Site, W. Hazleton, PA (Well E-12)
Date: 10/8/2014

	Estimates	Units	
Treatment Area Volume			
Length	90	ft	
Width	55	ft	
Area	4950	sq ft	
Thickness	80	ft	
Total Volume	14667	cu yd	
Soil Characteristics/Analysis			
Porosity	1.2	%	
Total Plume Pore Volume	35547	gal	
Avg Contaminant Conc	1	ppm	
Mass of Contaminant	0.30	lb	
PNOD	3.1	g/kg	
Effective PNOD	1	%	
Effective PNOD Calculated	0.031		
PNOD Oxidant Demand	1350.36	lb	
Avg Stoichiometric Demand	2.4	lb/lb	
Contaminant Oxidant Demand	0.71	lb	
Theoretical Oxidant Demand	1351.07	lb	
Confidence Factor	1		
Calculated Oxidant Demand	1351.072		
Injection Volumes for RemOx L			
RemOx L Injection Concentration	10.0%	%	
Calculated Specific Gravity	1.091623	g/ml	
Total Volume of Injection Fluid	1,332	gal	Two intervals; 650 gals/interval
Pore Volume Replaced	3.75	%	

Amount of RemOx L ISCO Reagent Estimated **3,033 pounds**
265 gallons

CARUS REMEDIATION TECHNOLOGIES

In Situ Chemical Oxidation (ISCO) *In Situ* Bioremediation (BIO) *In Situ* Biogeochemical Stabilization (ISBS)

RemOx® L ISCO Reagents Estimation Spreadsheet

Input data into box with blue font

Site Name: Valmont TCE Site, W. Hazleton, PA (Well E-13)
Date: 10/8/2014

	Estimates	Units	
Treatment Area Volume			
Length	90	ft	
Width	60	ft	
Area	5400	sq ft	
Thickness	56	ft	
Total Volume	11200	cu yd	
Soil Characteristics/Analysis			
Porosity	1.2	%	
Total Plume Pore Volume	27145	gal	
Avg Contaminant Conc	1	ppm	
Mass of Contaminant	0.23	lb	
PNOD	3.1	g/kg	
Effective PNOD	1	%	
Effective PNOD Calculated	0.031		
PNOD Oxidant Demand	1031.184	lb	
Avg Stoichiometric Demand	2.4	lb/lb	
Contaminant Oxidant Demand	0.54	lb	
Theoretical Oxidant Demand	1031.73	lb	
Confidence Factor	1.5		
Calculated Oxidant Demand	1547.592		
Injection Volumes for RemOx L			
RemOx L Injection Concentration	10.0%	%	
Calculated Specific Gravity	1.091623	g/ml	
Total Volume of Injection Fluid	1,526	gal	Two intervals; 750 gals/interval
Pore Volume Replaced	5.62	%	High yielding well (10 gpm)

Amount of RemOx L ISCO Reagent Estimated **3,474 pounds**
304 gallons

RemOx® L ISCO Reagents Estimation Spreadsheet

Input data into box with blue font

Site Name: Valmont TCE Site, W. Hazleton, PA (Well E-14)
Date: 10/8/2014

	Estimates	Units	
Treatment Area Volume			
Length	**90**	ft	
Width	**50**	ft	
Area	4500	sq ft	
Thickness	**80**	ft	
Total Volume	13333	cu yd	
Soil Characteristics/Analysis			
Porosity	**1.2**	%	
Total Plume Pore Volume	32316	gal	
Avg Contaminant Conc	**1**	ppm	
Mass of Contaminant	0.27	lb	
PNOD	**3.1**	g/kg	
Effective PNOD	**1**	%	
Effective PNOD Calculated	0.031		
PNOD Oxidant Demand	1227.6	lb	
Avg Stoichiometric Demand	**2.4**	lb/lb	
Contaminant Oxidant Demand	0.65	lb	
Theoretical Oxidant Demand	1228.25	lb	
Confidence Factor	**1**		
Calculated Oxidant Demand	1228.247		
Injection Volumes for RemOx L			
RemOx L Injection Concentration	**10.0%**	%	
Calculated Specific Gravity	1.091623	g/ml	
Total Volume of Injection Fluid	1,211	gal	Two intervals; 600 gals/interval
Pore Volume Replaced	3.75	%	

Amount of RemOx L ISCO Reagent Estimated **2,757 pounds**
241 gallons

RemOx® L ISCO Reagents Estimation Spreadsheet

Input data into box with blue font

Site Name: Valmont TCE Site, W. Hazleton, PA (Wells MW-10A, MW-11S, MW-13S, MW-13I, E-9)
Date: 10/7/2014

	Estimates	Units	
Treatment Area Volume			
Length	**45**	ft	
Width	**30**	ft	
Area	1350	sq ft	
Thickness	**10**	ft	
Total Volume	500	cu yd	
Soil Characteristics/Analysis			
Porosity	**1.2**	%	
Total Plume Pore Volume	1212	gal	
Avg Contaminant Conc	**0.21**	ppm	
Mass of Contaminant	0.00	lb	
PNOD	**3.1**	g/kg	
Effective PNOD	**1**	%	
Effective PNOD Calculated	0.031		
PNOD Oxidant Demand	46.035	lb	
Avg Stoichiometric Demand	**2.4**	lb/lb	
Contaminant Oxidant Demand	0.01	lb	
Theoretical Oxidant Demand	46.04	lb	
Confidence Factor	**3**		
Calculated Oxidant Demand	138.1203		
Injection Volumes for RemOx L			
RemOx L Injection Concentration	**10.0%**	%	10-foot screened well planning factor
Calculated Specific Gravity	1.091623	g/ml	Applies to MW-11S, MW-13S, MW-13I
Total Volume of Injection Fluid	136	gal	
Pore Volume Replaced	11.24	%	

Amount of RemOx L ISCO Reagent Estimated	**310 pounds**
	27 gallons